

SEMITOP®E2

3-phase 3-Level TNPC

SK25TMLID12F4TE2

Features*

- Optimized design for superior thermal performance
- Low inductive design
- Press-Fit contact technology
- 1200V Trench IGBT4 Fast (F4)
- 650V Trench IGBT3 (E3)
- Robust and soft switching CAL4F diode technology
- Integrated NTC temperature sensor
- UL recognized file no. E 63 532

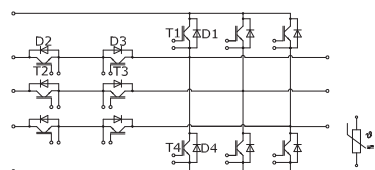
Typical Applications

- UPS
- Solar

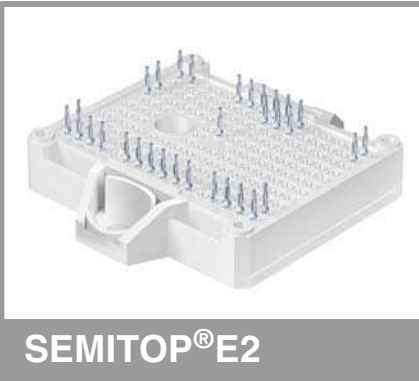
Remarks*

- Recommended $T_{jop} = -40 \dots +150^{\circ}\text{C}$
- IGBT1: outer IGBTs T1 & T4
- IGBT2: inner IGBTs T2 & T3
- Diode1: outer Diodes D1 & D4
- Diode2: inner Diodes D2 & D3

Absolute Maximum Ratings				
Symbol		Conditions	Values	Unit
IGBT1				
V _{CES}	T _J = 25 °C		1200	V
I _C	P12	T _s = 25 °C	34	A
	T _J = 175 °C	T _s = 70 °C	27	A
I _C	HPTP / HP-PCM	T _s = 25 °C	41	A
	T _J = 175 °C	T _s = 70 °C	33	A
I _{Cnom}			25	A
I _{CRM}			50	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 800 V, V _{GE} ≤ 15 V, T _J = 150 °C, V _{CES} ≤ 1200 V		6	µs
T _J			-40 ... 175	°C
IGBT2				
V _{CES}	T _J = 25 °C		650	V
I _C	P12	T _s = 25 °C	38	A
	T _J = 175 °C	T _s = 70 °C	31	A
I _C	HPTP / HP-PCM	T _s = 25 °C	44	A
	T _J = 175 °C	T _s = 70 °C	36	A
I _{Cnom}			30	A
I _{CRM}			50	A
V _{GES}			-20 ... 20	V
t _{psc}	V _{CC} = 360 V, V _{GE} ≤ 15 V, T _J = 150 °C, V _{CES} ≤ 650 V		6	µs
T _J			-40 ... 175	°C
Diode1				
V _{RRM}	T _J = 25 °C		1200	V
I _F	P12	T _s = 25 °C	30	A
	T _J = 175 °C	T _s = 70 °C	24	A
I _F	HPTP / HP-PCM	T _s = 25 °C	35	A
	T _J = 175 °C	T _s = 70 °C	28	A
I _{FRM}			50	A
I _{FSM}	10 ms, sin 180°, T _J = 25 °C		100	A
T _J			-40 ... 175	°C
Diode2				
V _{RRM}	T _J = 25 °C		650	V
I _F	P12	T _s = 25 °C	33	A
	T _J = 175 °C	T _s = 70 °C	26	A
I _F	HPTP / HP-PCM	T _s = 25 °C	37	A
	T _J = 175 °C	T _s = 70 °C	29	A
I _{FRM}			50	A
I _{FSM}	10 ms, sin 180°, T _J = 25 °C		180	A
T _J			-40 ... 175	°C
Module				
I _{t(RMS)}	ΔT _{terminal} at PCB joint = 30 K, per pin		30	A
T _{stg}	module without TIM		-40 ... 125	°C
V _{isol}	AC, sinusoidal, t = 1 min		2500	V



TMLID-T



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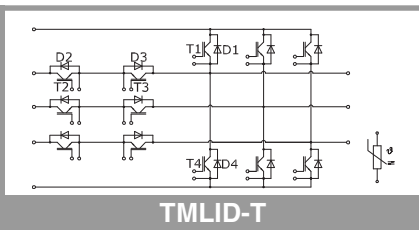
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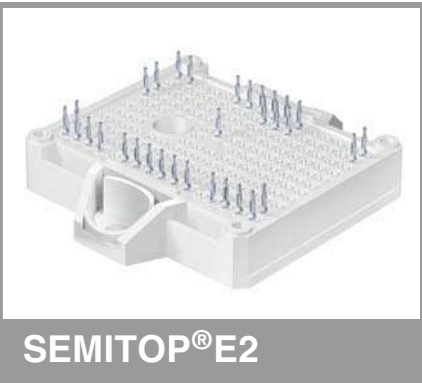
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Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
IGBT1						
V _{CE(sat)}	I _C = 25 A	T _j = 25 °C		2.05	2.42	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		2.59	2.96	V
V _{CE0}	chiplevel	T _j = 25 °C		1.10	1.28	V
		T _j = 150 °C		0.95	1.13	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		38	46	mΩ
	chiplevel	T _j = 150 °C		66	73	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 0.85 mA		5.2	5.8	6.4	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 1200 V, T _j = 25 °C				1	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		1.43		nF
C _{oes}		f = 1 MHz		t.b.d.		nF
C _{res}		f = 1 MHz		0.085		nF
Q _G	V _{GE} = -15 V ... +15 V			207		nC
R _{Gint}	T _j = 25 °C			0		Ω
t _{d(on)}	V _{CE} = 300 V	T _j = 150 °C		33		ns
t _r	I _C = 25 A	T _j = 150 °C		35		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		0.91		mJ
t _{d(off)}	R _{G on} = 20 Ω	T _j = 150 °C		200		ns
t _f	R _{G off} = 20 Ω	T _j = 150 °C		81		ns
E _{off}	di/dt _{on} = 760 A/us di/dt _{off} = 470 A/us dV/dt _{off} = 4000 V/us	T _j = 150 °C		0.91		mJ
R _{th(j-s)}	per IGBT, P12			1.17		K/W
R _{th(j-s)}	per IGBT, HPTP / HP-PCM			0.85		K/W
IGBT2						
V _{CE(sat)}	I _C = 25 A	T _j = 25 °C		1.36	1.73	V
	V _{GE} = 15 V chiplevel	T _j = 150 °C		1.55	1.90	V
V _{CE0}	chiplevel	T _j = 25 °C		0.90	1.00	V
		T _j = 150 °C		0.82	0.90	V
r _{CE}	V _{GE} = 15 V	T _j = 25 °C		18	29	mΩ
	chiplevel	T _j = 150 °C		29	40	mΩ
V _{GE(th)}	V _{GE} = V _{CE} , I _C = 0.43 mA		5.1	5.8	6.4	V
I _{CES}	V _{GE} = 0 V, V _{CE} = 650 V, T _j = 25 °C				1	mA
C _{ies}	V _{CE} = 25 V V _{GE} = 0 V	f = 1 MHz		1.63		nF
C _{oes}		f = 1 MHz		0.108		nF
C _{res}		f = 1 MHz		0.05		nF
Q _G	V _{GE} = -15 V ... +15 V			273		nC
R _{Gint}	T _j = 25 °C			0		Ω
t _{d(on)}	V _{CE} = 300 V	T _j = 150 °C		27		ns
t _r	I _C = 25 A	T _j = 150 °C		26		ns
E _{on}	V _{GE} = +15/-15 V	T _j = 150 °C		0.51		mJ
t _{d(off)}	R _{G on} = 15 Ω	T _j = 150 °C		247		ns
t _f	R _{G off} = 15 Ω	T _j = 150 °C		30		ns
E _{off}	di/dt _{on} = 820 A/us di/dt _{off} = 390 A/us dV/dt _{off} = 3600 V/us	T _j = 150 °C		0.81		mJ
R _{th(j-s)}	per IGBT, P12			1.57		K/W
R _{th(j-s)}	per IGBT, HPTP / HP-PCM			1.23		K/W



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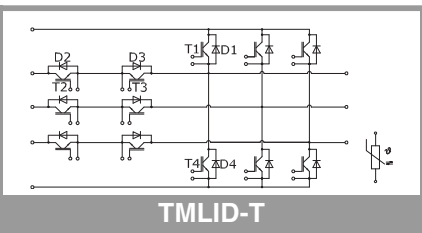
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- IGBT2: inner IGBTs T2 & T3
- Diode1: outer Diodes D1 & D4
- Diode2: inner Diodes D2 & D3

Characteristics						
Symbol	Conditions		min.	typ.	max.	Unit
Diode1						
V _F = V _{EC}	I _F = 25 A	T _j = 25 °C		2.41	2.74	V
	chiplevel	T _j = 150 °C		2.45	2.79	V
V _{F0}	chiplevel	T _j = 25 °C		1.30	1.50	V
		T _j = 150 °C		0.90	1.10	V
r _F	chiplevel	T _j = 25 °C		44	50	mΩ
		T _j = 150 °C		62	68	mΩ
I _{RRM}	I _F = 25 A	T _j = 150 °C		36		A
Q _{rr}	V _R = 300 V	T _j = 150 °C		1.99		μC
E _{rr}	V _{GE} = +15/-15 V	T _j = 150 °C		0.40		mJ
R _{th(j-s)}	per Diode, P12			1.68		K/W
R _{th(j-s)}	per Diode, HPTP / HP-PCM			1.31		K/W
Diode2						
V _F = V _{EC}	I _F = 25 A	T _j = 25 °C		1.50	1.92	V
	chiplevel	T _j = 150 °C		1.55	2.01	V
V _{F0}	chiplevel	T _j = 25 °C		1.04	1.24	V
		T _j = 150 °C		0.85	0.99	V
r _F	chiplevel	T _j = 25 °C		19	27	mΩ
		T _j = 150 °C		28	41	mΩ
I _{RRM}	I _F = 25 A	T _j = 150 °C		25		A
Q _{rr}	V _R = 300 V	T _j = 150 °C		3.16		μC
E _{rr}	V _{GE} = +15/-15 V	T _j = 150 °C		0.61		mJ
R _{th(j-s)}	per Diode, P12			1.82		K/W
R _{th(j-s)}	per Diode, HPTP / HP-PCM			1.44		K/W
Module						
L _{sCE1}				-		nH
L _{CE}				-		nH
R _{CC'+EE'}		T _s = 25 °C		-		mΩ
		T _s = 150 °C		-		mΩ
M _s	to heatsink		1.6		2.3	Nm
M _t				-		Nm
						Nm
w				35		g
Temperature Sensor						
R ₁₀₀	T _C =100°C (R ₂₅ =5 kΩ)			493 ± 5%		Ω
B _{100/125}	R _(T) =R ₁₀₀ exp[B _{100/125} (1/T-1/T ₁₀₀)]; T[K];			3550 ±2%		K



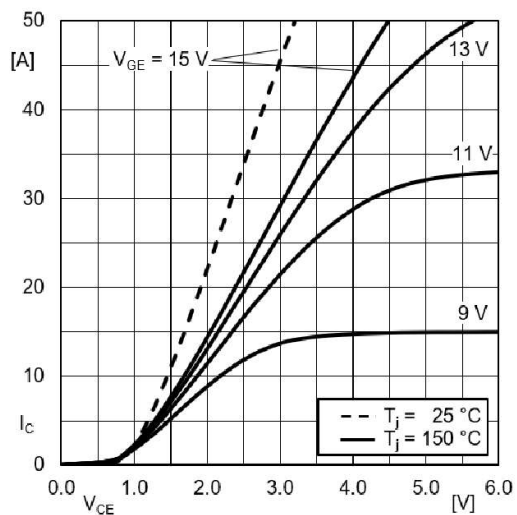


Fig. 1: Typ. IGBT1 output characteristic, incl. $R_{CC}+EE'$

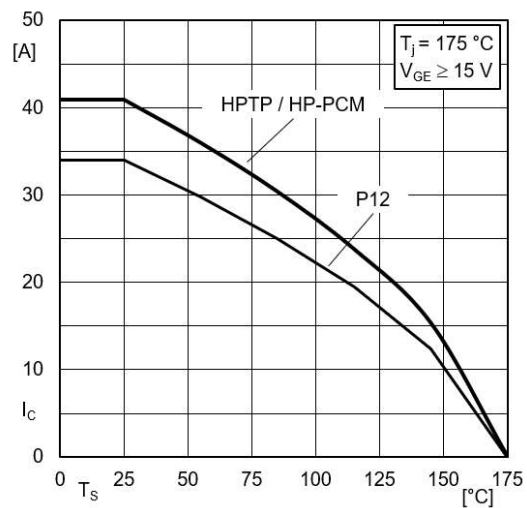


Fig. 2: IGBT1 rated current vs. Temperature $I_C=f(T_s)$

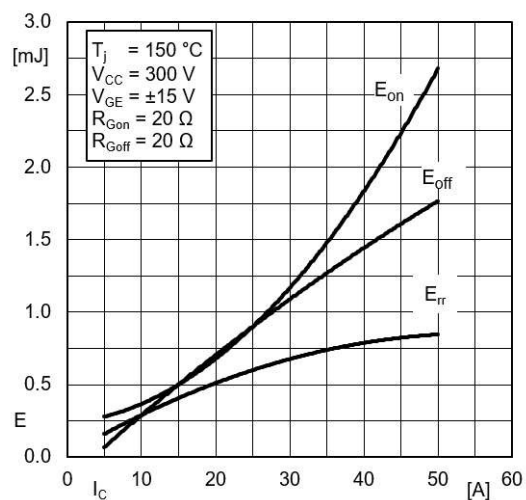


Fig. 3: Typ. IGBT1 & Diode2 switching energy $E = f(I_D)$

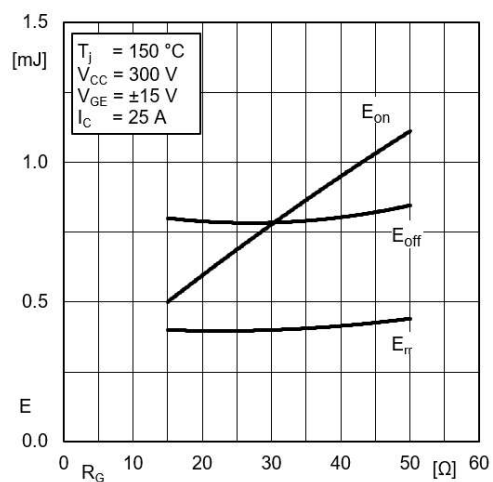


Fig. 4: Typ. IGBT1 & Diode2 switching energy $E = f(R_G)$

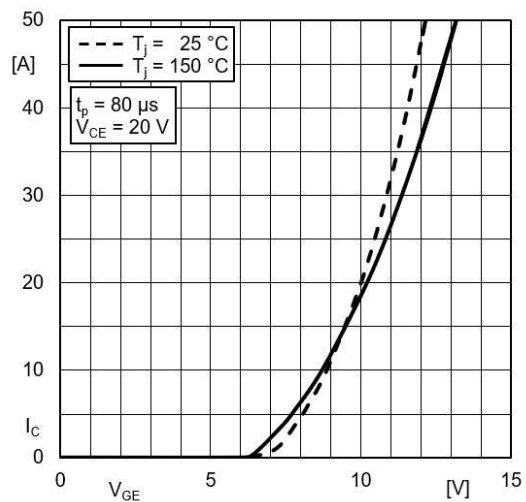


Fig. 5: Typ. IGBT1 transfer characteristic

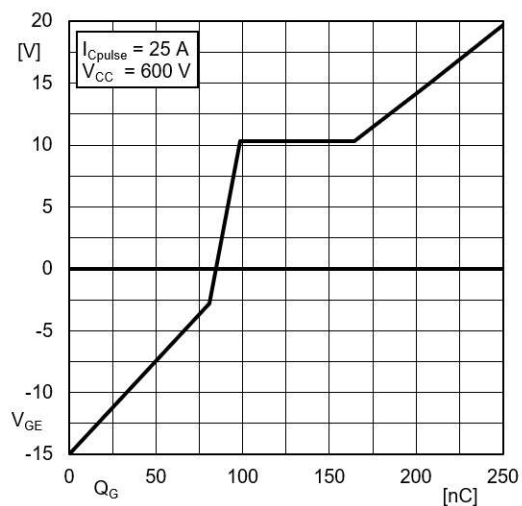


Fig. 6: Typ. IGBT1 gate charge characteristic

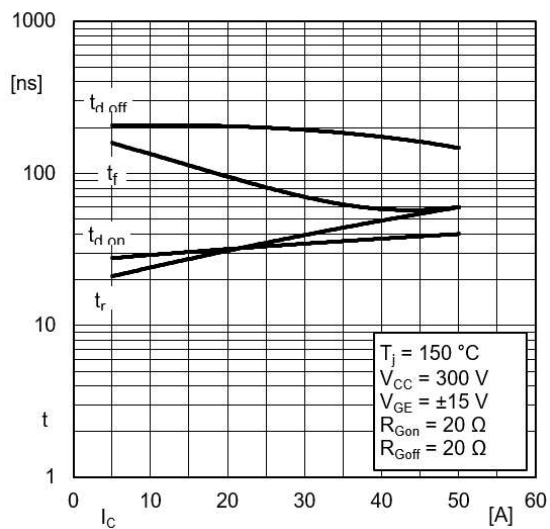


Fig. 7: Typ. IGBT1 switching times $t = f(I_D)$

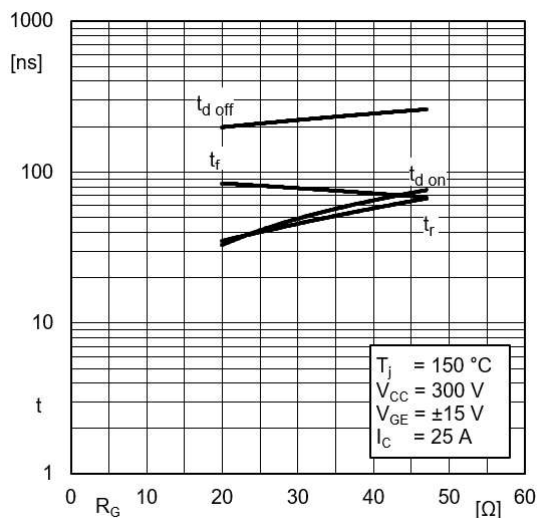


Fig. 8: Typ. IGBT1 switching times $t = f(R_G)$

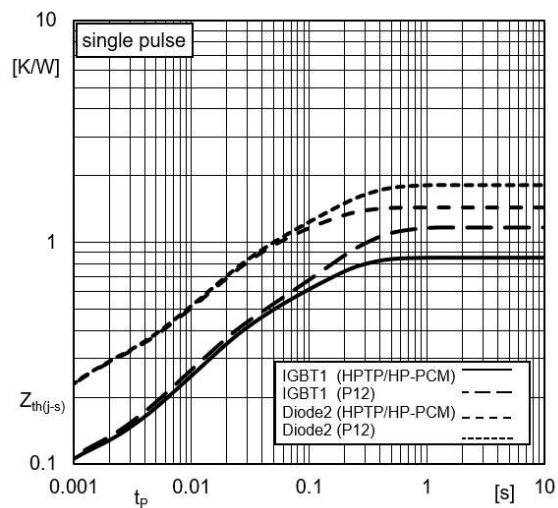


Fig. 9: Typ. transient thermal impedance

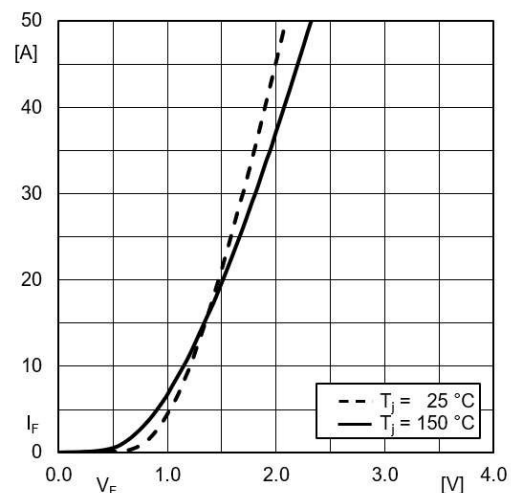


Fig. 10: Typ. Diode1 forward characteristic, incl. $R_{CC+EE'}$

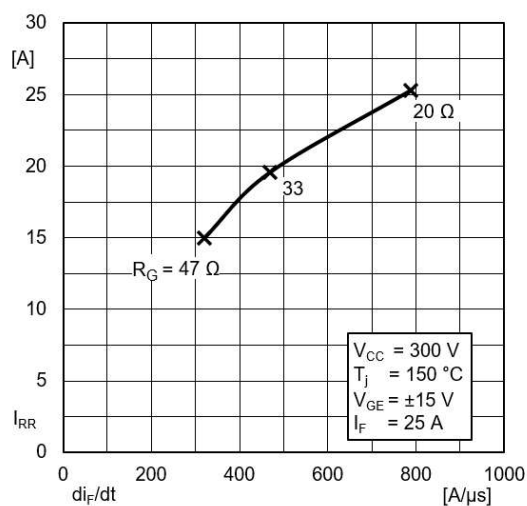


Fig. 11: Typ. Diode2 peak reverse recovery current

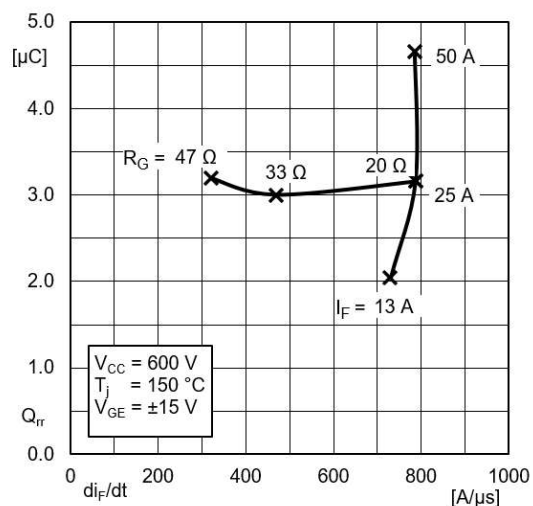


Fig. 12: Typ. Diode2 reverse recovery charge

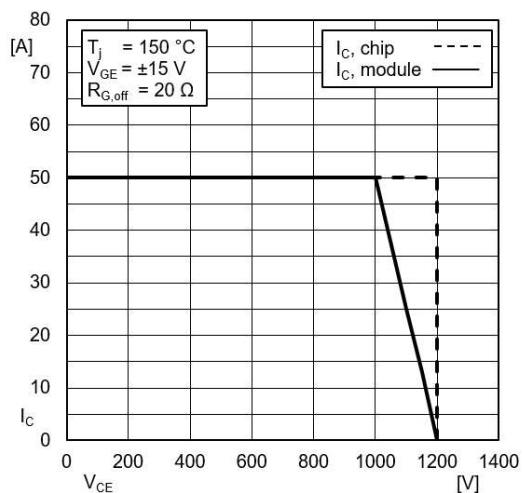


Fig. 13: IGBT1 Reverse Bias Safe Operating Area (RBSOA)

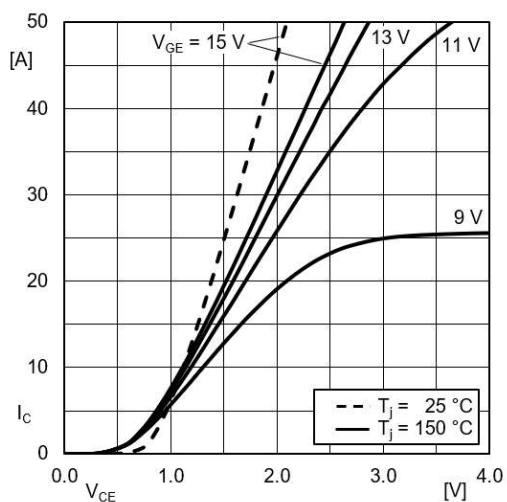


Fig. 14: Typ. IGBT2 output characteristic, incl. $R_{CC} + EE'$

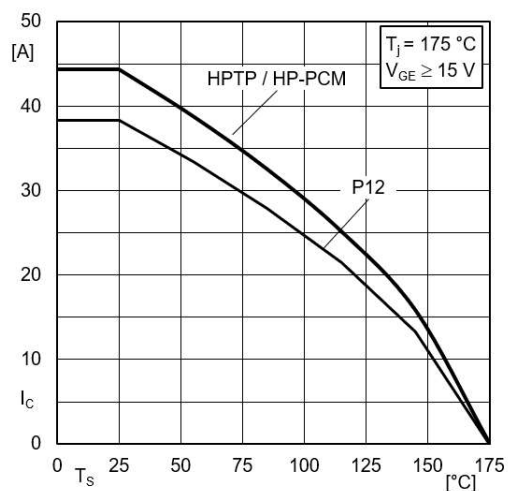


Fig. 15: IGBT2 rated current vs. Temperature $I_c=f(T_s)$

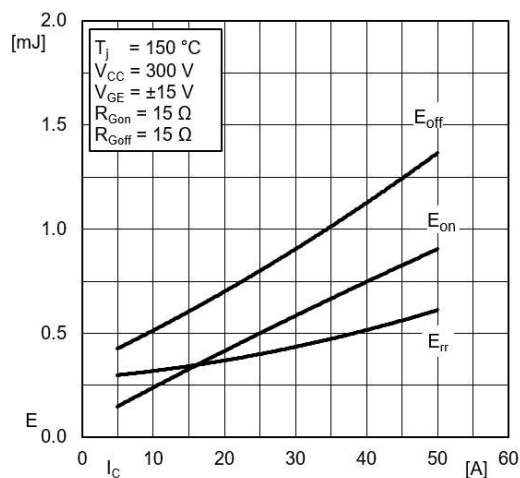


Fig. 16: Typ. IGBT2 & Diode1 switching energy $E = f(I_D)$

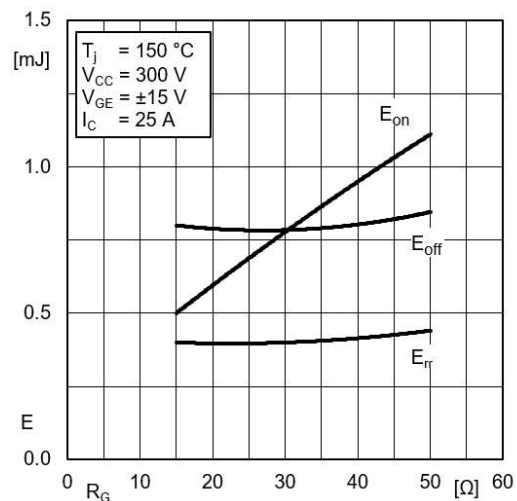


Fig. 17: Typ. IGBT2 & Diode1 switching energy $E = f(R_G)$

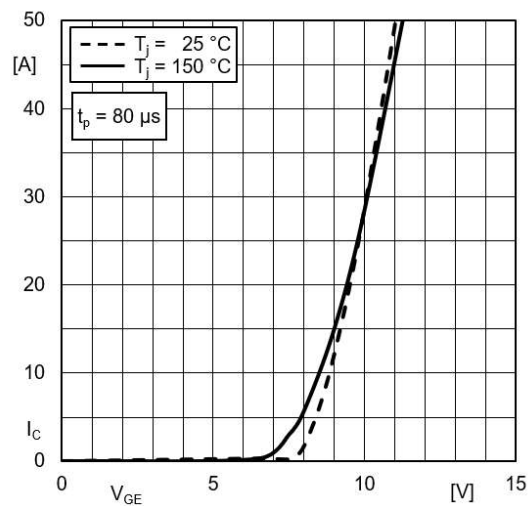


Fig. 18: Typ. IGBT2 transfer characteristic

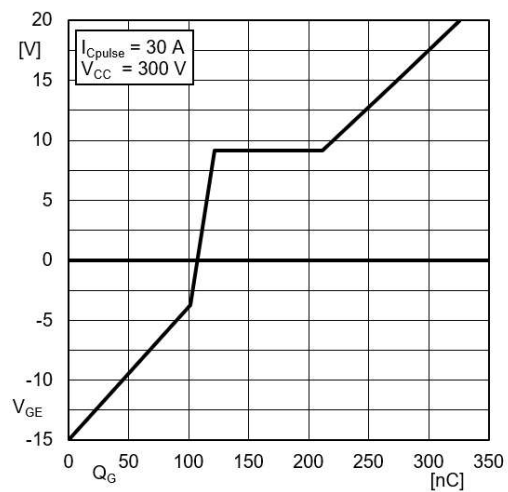


Fig. 19: Typ. IGBT2 gate charge characteristic

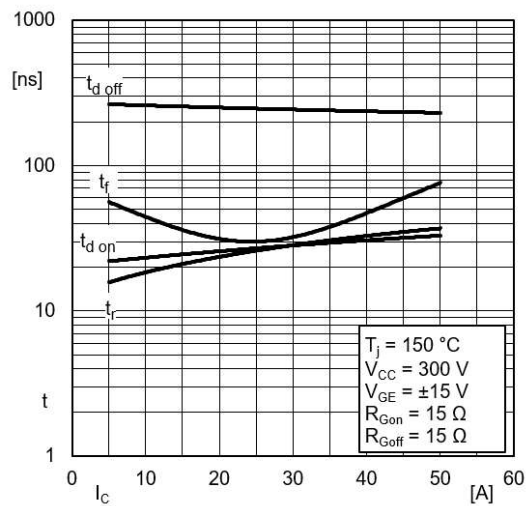


Fig. 20: Typ. IGBT2 switching times $t = f(I_D)$

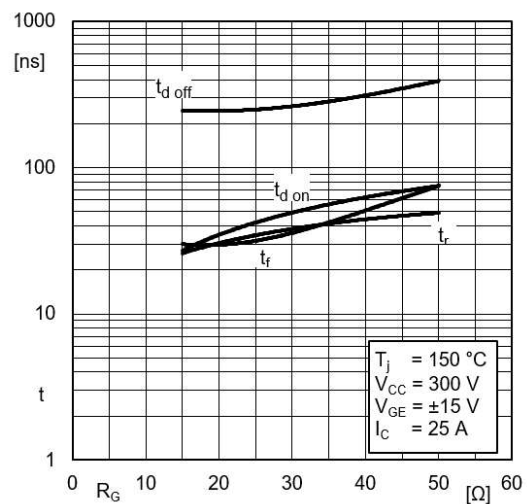


Fig. 21: Typ. IGBT2 switching times $t = f(R_G)$

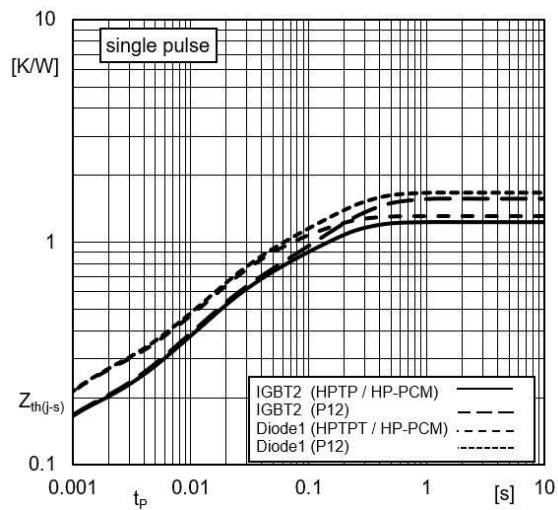


Fig. 22: Typ. transient thermal impedance

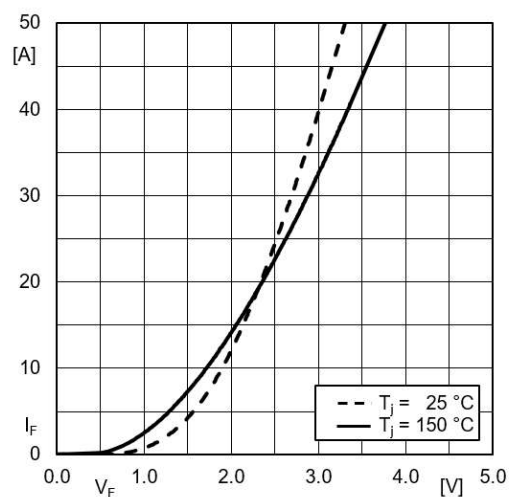


Fig. 23: Typ. Diode1 forward characteristic, incl. $R_{CC'+EE'}$

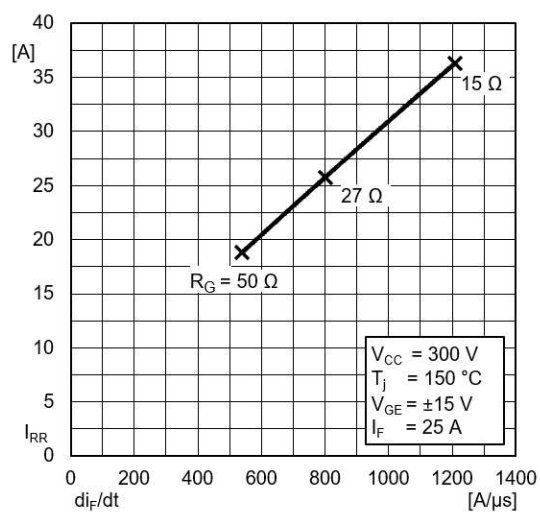


Fig. 24: Typ. Diode1 peak reverse recovery current

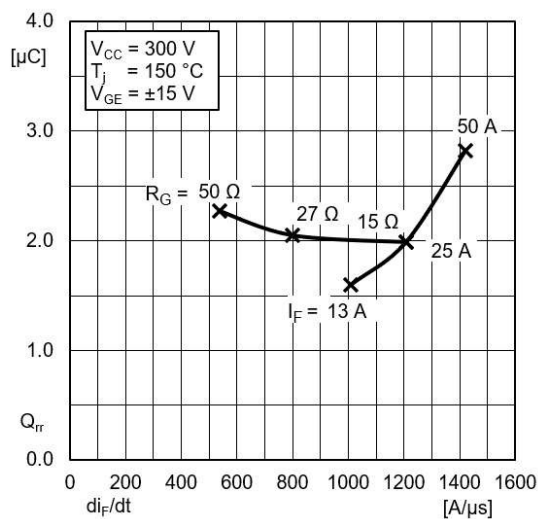


Fig. 25: Typ. Diode1 reverse recovery charge

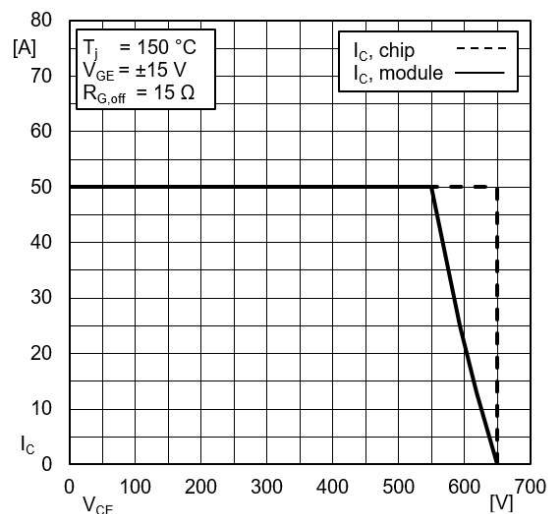
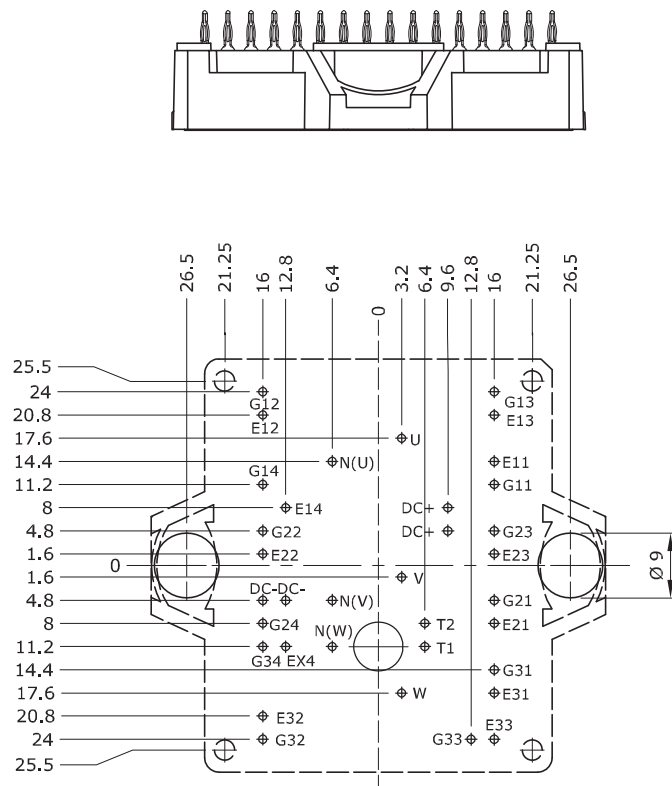
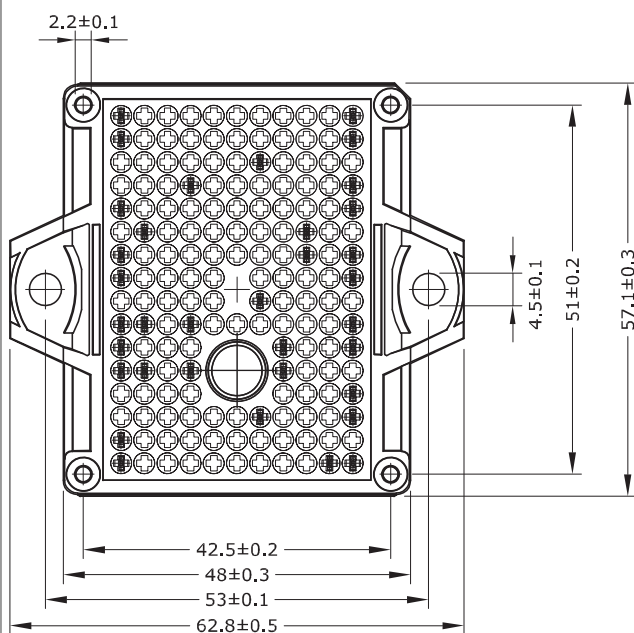
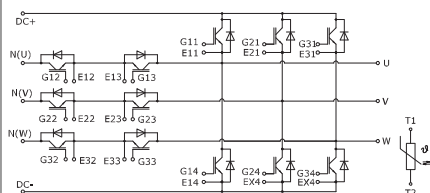


Fig. 26: IGBT2 Reverse Bias Safe Operating Area (RBSOA)



- Pin-Grid 3.2 mm
- Tolerance of PCB hole pattern $\boxed{\oplus \boxed{\varnothing 0.1}}$
- Diameters of drill $\varnothing$ 1.15mm
- Copper thickness in hole 25 - 50 μ m
- Hole specification for contacts:
refer to SEMITOP E1/E2 Mounting Instruction



TMLID-T

This is an electrostatic discharge sensitive device (ESDS) due to international standard IEC 61340.

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